MCR-T-UI(-E)...
MCR Temperature Measuring Transducer

1. Description

A universal temperature measuring transducer for resistance thermometers and thermocouples, with freely selectable temperature range, is available for the MCR-T converters (resistance thermometer: -200°C to 850°C [-328˚F to +1562˚F]), thermocouple sensors: -200°C to 2300°C [-328˚F to +4172˚F]).

The analog standard signals 0(4)…20 mA, 0…10 V, ±10 V, 0(1)…5 V, ±5 V can be used with normal (e.g., 0…10 V) and inverse (e.g., 10…0 V) action on the output side.

A PNP transistor switching output (100 mA) with two switching points and 8 switching functions provides an additional monitoring function.

1.1. Versions

- With standard configuration - MCR-T-UI(-E)/NC - (PT100 DIN IEC 751 3-wire from -200…850°C (-328˚F… 1562˚F) with 4…20 mA output and disabled switching output)

- With project-specific configuration - MCR-T-UI(-E) - The configuration should be specified in the order key (see Page 5). Upon delivery the module is configured according to user requirements and therefore ready to operate.

- The modules can be parameterized freely using the configuration kit MCR-CONF-WIN or MCR/PI-CONF-WIN.

1.2. Input

The following sensor types and input signals can be processed on the input side:

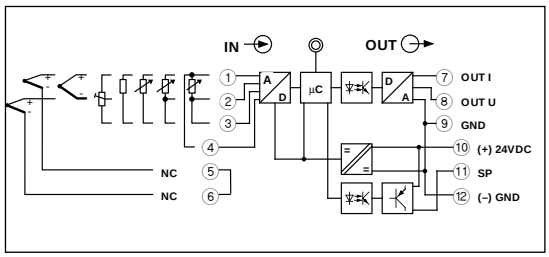
- Resistance thermometers in 2, 3 or 4-wire version
- Thermocouple sensors
- Thermocouple sensors of the same type connected in series for measuring temperature differentials
- mV voltages from -20 mV to +2400 mV
- Linear resistors in the range from 0 Ω to 8000 Ω
- Potentiometers up to 8 kΩ

1.3. Output

The MCR-T… has two outputs:

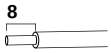
- Analog output with either 0(4)…20 mA or 0…10 V, ±10 V, 0(1)…5 V, ±5 V with normal or inverse action (e.g., 0...10 V /10…0 V). The loads must not fall below a voltage output of 10 kΩ and must not exceed a current output of 500 Ω.
- PNP transistor switching output (100 mA) without free-wheeling diode but with suppressor diode for transient protection. The configuration kit MCR-CONF-WIN... or MCR/PI-CONF-WIN is required to program this output.

2. Technical Data



MCR-T-UI(-E)/...

with signal conversion: resistance thermometer and thermocouple/± 5 V; ± 10 V; 0(1)…5 V; 0…10 V; 0…20 mA; 4…20 mA



	fixed [mm²]	flexible	AWG
Connection data	0.2-2.5	0.2-2.5	24-14

Housing width 17.5 mm (0.689 in.)

Description		Type	Order No.	Pcs. Pkt.
MCR-T module, not configured, for thermocouple sensors and resistance thermometers, in 2, 3 or 4-wire technology	0…20 mA, 4…20 mA, 0(1)…5 V, 0…10 V, ± 5 V, ± 10 V (also inverse signals)	**MCR-T-UI/NC**	**28 14 10 0**	1
MCR-T module, as above. Configured version	0…20 mA, 4…20 mA, 0…5 V, 0…10 V, 1...5 V, ± 5 V, ± 10 V	**MCR-T-UI 1)**	**28 14 09 0**	1
MCR-T module, not configured, for thermocouple sensors and resistance thermometers, in 2, 3 or 4-wire technology, with electrical isolation of input/output and input/power supply	0…20 mA, 4…20 mA, 0(1)…5 V, 0…10 V, ± 5 V, ± 10 V (also inverse signals)	**MCR-T-UI-E/NC**	**28 14 12 6**	1
MCR-T module, as above. Configured version	0…20 mA, 4…20 mA, 0…5 V, 0…10 V, 1...5 V, ± 5 V, ± 10 V	**MCR-T-UI-E** [1])	**28 14 11 3**	1

[1]) Specify configuration! (See order example on the last page)

Technical Data

Input	
Input	Resistance thermometer in 2, 3 or 4-wire technology Thermocouple sensors (B, E, J, K, N, R, S, T, L, U, C, W, HK) Linear mV signals from - 20 mV to + 2400 mV
Supply current (resistance thermometer)	250 µA
Input protection	Transient protection, surge protection 30 V DC
Connection method	Plug-in screw-clamp connection

Additional technical data can be found on page 3

Output							
Output signal	0…20 mA	4…20 mA	0(1)…5 V	0…10 V	± 5 V	± 10 V	
Maximum output signal	24 mA	24 mA	±12 V	±12 V	±12 V	± 12 V	
D/A resolution	± 12 bits						
Load	≤ 500 Ω	≤ 500 Ω	≥ 10 kΩ	≥ 10 kΩ	≥ 10 kΩ	≥ 10 kΩ	
Ripple	< 20 mV_{pp}						
Open-circuit response	From - 12 V to + 12 V or 0 mA to 24 mA						
Measuring range exceeded/not reached	From - 12 V to + 12 V or 0 mA to 24 mA						
Output protection	Transient protection						
Switching output	PNP transistor output, with a load capacity of 100 mA, switches supply voltage; disabled for project-specific configuration, otherwise can be freely programmed using MCR-CONF-WIN-... and MCR/PI-CONF-WIN.						

General Data		
Supply voltage		18...30 V DC
Current consumption		≤ 60 mA
Transmission error		≤ 0.1% of the final value, + 6 mV or 12 µA at the output
Cold junction error		≤ 3 K, typical 1.5 K
Temperature coefficient		≤ 0.01%/K, typical 0.005%/K
Ambient temperature range		- 20°C to + 65°C (-4°F to 149°F)
Test voltage (only MCR-T-UI-E...)	Input/output	1 kV, 50 Hz, 1 minute
	Input/power supply	1 kV, 50 Hz, 1 minute
Approbation		GL

CE

Conforms to the EMC Directive 89/336/EEC and the Low Voltage Directive 73/23/EEC

EMC (electromagnetic compatibility)		
Noise immunity according to 50082-2		
• Electrostatic discharge (ESD)	EN 61000-4-2	8 kV air discharge[2)] 4 kV contact discharge[2)]
• Electromagnetic HF field	EN 61000-4-3	
Amplitude modulation		10 V/m[1)]
Pulse modulation		10 V/m[1)]
• Fast transients (burst)	EN 61000-4-4	Input/output/supply: 2 kV/5 kHz[2)]
• Conducted interference	EN 61000-4-6	Input/output/supply: 10 V[1)]
Noise emission according to EN 50081-2	EN 55011	Class A

EN 61000 corresponds to IEC 1000/
EN 55011 corresponds to CISPR22

[1)]Criterion A: normal operating characteristics within the specified limits.
[2)]Criterion B: temporary adverse effects on the operating characteristics which the device corrects itself.

Class A: industrial application without special installation measures

These results were achieved using shielded cables.

MCR-T-UI ... MCR Temperature Measuring Transducer

① Programming interface

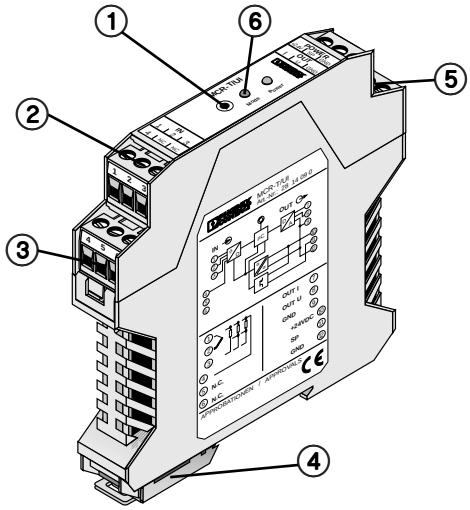
② Plug-in screw-clamp terminals (COMBICON)

③ Shield connection (on terminal 5 or 6)

④ Metal lock for fastening on the DIN rail

⑤ Plug-in screw-clamp terminals (COMBICON)

⑥ Error LED



3. Method of Operation

The analog input signal of the temperature sensor is digitized with a 24-bit resolution and then supplied to a microcontroller. The microcontroller forms a digital output value in line with the temperature from the input signal. This is supplied via optocouplers to a D/A converter after electrical isolation. The corresponding output signals are realized using a subsequent voltage or current level (e.g., 0…10 V, 0…20 mA).

The microcontroller has an integrated memory in which the program sequence for the measured value calculation is stored. The user-specific parameters are stored in an EEPROM (electrically erasable programmable read-only memory). The programmed data remains in the memory even after the supply voltage has been disconnected.

4. Connections

4.1. Thermocouple Sensors

- Simple temperature measurement
  For temperature measurement using the thermocouple sensors described on page 5, the terminal points ① and ② of the MCR-T should be connected taking into consideration the polarity of the sensor.
  (① ≙ "+" input; ② ≙ "–" input)

- Differential temperature measurement
  To measure temperature differentials with only one temperature measurement converter, the MCR-T… offers the option of connecting two thermocouple sensors of the same type in series and laying the two remaining branches to terminal points ① and ②. The connection ends of the two thermocouple sensors can be fixed to terminal points ⑤ and ⑥ (see corresponding circuit diagram). The differential temperature measurement can only be set using the configuration software MCR-CONF-WIN… or MCR/PI-CONF-WIN because the internal cold junction compensation must be switched off for this.

4.2. Resistance Thermometer

For temperature measurement using the resistance thermometers described on page 5, the terminal points must be connected according to the wire connection method (see corresponding circuit diagram); ① and ③ for 2-wire, ①, ② and ③ for 3-wire and ①, ②, ③ and ④ for 4-wire technology.

4.3. Measurement of mV Voltages

Voltages in the range from -20…+2400 mV are measured at terminal points ① and ②, where ① is the "+" input and ② is the "–" input.

4.4. Measurement of Resistance

To measure differing resistance between 0…8000 Ω, terminal points ① and ③ are used. The connection is made using 2-wire technology.

4.5. Evaluation of Potentiometer Settings

To evaluate potentiometers up to 8 kΩ, terminals ① and ③ are connected with the external cables and terminal 2 is connected ② with the loop cable.

4.6. Switching Output

The PNP transistor switching output switches the supply voltage U_B when the programmed switching conditions are met from 24 V on terminal ⑪. The transistor output should only be loaded with a maximum of 100 mA.

A suppressor diode protects this output from fast transients.

5. Error Detection:

Open Circuit/Measuring Range Exceeded or Not Reached

Display of open circuit/measuring range exceeded or not reached for project-specific configured modules:

- The red MODE LED is permanently on.
- The following voltages and currents can be measured at the output using the selected output signal configuration:

Output Signal	Output Signal at	
	Open Circuit	Measuring Range Exceeded/ Not Reached
0...5 V; ±5 V	5.5 V	5.25 V
0...10 V; ±10 V	11 V	10.5 V
0...20 mA	22 mA	21 mA
4...20 mA	22 mA	21 mA

During independent configuration, values between -12…+12 V and 0…24 mA can be set freely.

6. Changing the Configuration Data

To change the configuration data, use the configuration kit MCR-CONF-WIN… or MCR/PI-CONF-WIN. An additional User Manual and online help for the software provide a more detailed explanation of the configuration options and how to carry them out.

The adapter cable MCR-TTL/RS232-E should be used to connect the module and the PC. This is not contained in the configuration kit.

7. Order Key for the Programmable Temperature Measuring Transducer

Resistance Thermometer

(Temperature Ranges According to IEC 751/EN 60 751 and DIN 43 760 SAMA RC 21-4-1966 in 2, 3 or 4-Wire Version)

Sensor Type [1)]	Measuring Range	Standard	Minimum Measuring Range Span
Pt sensors	-200°C...850°C	(DIN/SAMA)	0.4 K
Ni sensors	-60°C...180°C	(DIN/SAMA)	0.4 K
Cu sensors	-70°C...500°C	(SAMA)	0.4 K
Ni 1000	-50°C...160°C	(Landis & Gyr)	0.4 K
Cu 50	-50°C...200°C	–	0.4 K
Cu 53	-50°C...180°C	–	0.4 K
KTY 81-110	-55°C...150°C	(Philips)	0.4 K

[1]) Additional types or characteristics on request.

Equation to convert temperatures from°C to °F:

$$T\,[°F] = \frac{9}{5} \cdot T\,[°C] + 32$$

Thermocoup es

Sensor Type [1)]	Thermo-couple	Measuring Range	Minimum Measuring Range Span
U [2)]	Cu-CuNi	-200°C...600°C	> 1 K
T [2)]	Cu-CuNi	-200°C...400°C	> 1 K
L [2)]	Fe-CuNi	-200°C...900°C	> 1 K
J [2)]	Fe-CuNi	-210°C...1200°C	> 1 K
E [2)]	NiCr-CuNi	-226°C...900°C	> 1 K
K [2)]	NiCr-Ni	-200°C...1372°C	> 1 K
N [2)]	NiCrSi-NiSi	-200°C...1300°C	> 1 K
S [2)]	Pt10Rh-Pt	-50°C...1768°C	> 4 K
R [2)]	Pt13Rh-Pt	-50°C...1768°C	> 4 K
B [2)]	Pt30Rh-Pt6Rh	500°C...1820°C	> 10 K
C		-18°C...2316°C	> 4 K
W		-18°C...2316°C	> 4 K
HK		-200°C...800°C	> 1 K

[2]) Thermocouples according to IEC 584/EN 60584

Resistors, Potentiometers, mV Vo tages

Input	Measuring Range	Order Reference	Minimum Measuring Range Span
Resistor	0 Ω … 8000 Ω (2-wire)	RES	2 Ω
Potentiometer (max. 8 kΩ)	0 … 100% (3-wire)	POT	0.2%
Voltage	-20 mV …+2400 mV	VOL	2 mV

Order Key for MCR-T-UI-E (Order No. 28 14 11 3) and MCR-T-UI (Order No. 28 14 09 0)

The standard configuration will be supplied if customer order details are incorrect or not provided.

Standard configuration:

	Sensor Type	Characteristic	Connection	Measuring	
MCR-T-UI-E	/ PT100	/ D	/ 3	/ -200.0	/ +850.0 /
	See tables above under "Sensor Type" and "Order Reference"	D ≙ DIN S ≙ SAMA (see above table) 0 ≙ for thermocouple, resistor, potentiometer, voltage, Ni1000 (Landis&Gyr)Cu 10, KTY 81-110, Cu50, Cu53	2 ≙ 2-wire 3 ≙ 3-wire 4 ≙ 4-wire 0 ≙ for thermocouple, resistor, potentiometer, voltage,	**Start value** at 0 mA (e.g., -200.0°C [-328˚F])	**Final value** at 20 mA (e.g., +850.0°C [+1562˚F)

Measuring Unit	Output	Output Characteristic
/ 1	/ 2	/ 1
1 ≙°C 2 ≙ °F 3 ≙ mV 4 ≙ Ω 5 ≙ %	0 ≙ 0…10 V 1 ≙ 0 … 5 V 2 ≙ 0…20 mA 3 ≙ 4…20 mA 4 ≙ -10…+10 V 5 ≙ -5 … +5 V	1 ≙ normal 2 ≙ inverse

Order Examples for MCR-T-UI(-E) With Different Input Versions:

Resistance Thermometer

MCR-T-UI-E	PT100	D	3	-200.0	+850.0	1	3	1

(Configuration for 3-wire PT100 sensor: according to DIN of -200.0°C to +850.0°C with 4…20 mA output characteristic)

Thermocouple

MCR-T-UI-E	J	0	0	-346	+2192	2	3	2

(Configuration for thermocouple Type J from -346°F to +2192°F with 20…4 mA output characteristic)

Voltage

MCR-T-UI-E	VOL	0	0	-10	1200	3	0	2

(Configuration for voltage input from -10 mV to +1200 mV with 10…0 V output characteristic)

Resistor (2-wire connection)

MCR-T-UI-E	RES	0	0	0	7500	4	1	1

(Configuration to connect a resistor that varies between 0 Ω and 7500 Ω. The output signal is 0…5 V.)

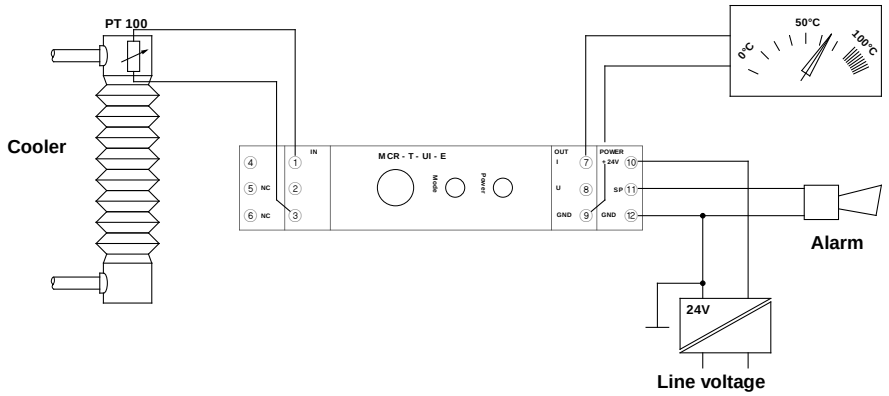
Potentiometer (3-wire connection)

MCR-T-UI-E	POT	0	0	10	90	5	3	1

(Configuration for connecting a 3-wire potentiometer, where 10 - 90% of the range is used. The output is 4…20 mA.)

8. Application Example

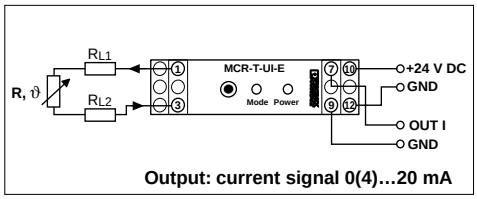
Temperature monitoring with a PT100 element in 2-wire technology when using the transistor switching output



9. Connection Examples

Application;

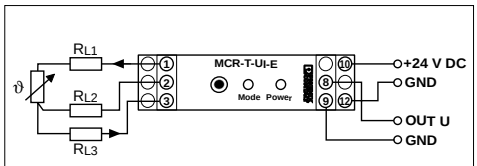
- For short distances (< 10 m [32.808 ft.])
  Please note:
- The cable resistances R_{L1} and R_{L2} directly affect the measuring result and make it incorrect (example for PT100: 0.385 Ω ≙ 1 K). Compensation of ± 5% is possible.



Output: current signal 0(4)…20 mA

Application;

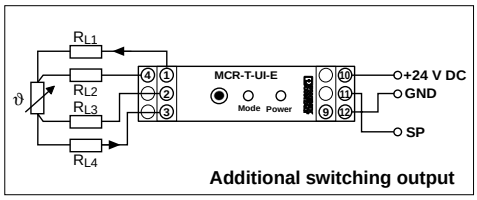
- For longer distances between PT 100 sensor and the MCR module (R_{L1}, R_{L2}, $R_{L3} \leq 25\ \Omega$)
  Please note:
- To compensate the cable resistance, all cable resistances must have exactly the same values ($R_{L1} = R_{L2} = R_{L3}$)



Output: voltage signal 0(1)…(5)10 V, ±(5)10 V

Application;

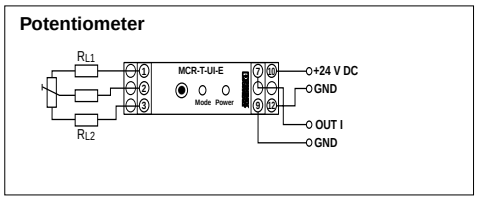
- For longer distances between the PT 100 sensor and the MCR module and varied cable resistances ($R_{L1} \neq R_{L2} \neq R_{L3} \neq R_{L4}$)
  Please note:
- The cable resistance ($R_{L2} + R_{L4}$) should not exceed 50 Ω.



Additional switching output

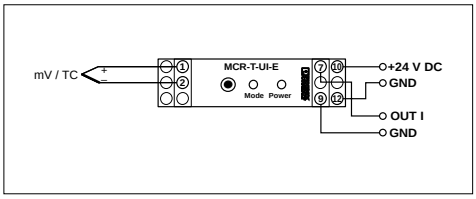
Application;

- For short distances and slow changes.
  Please note:
- The cable resistances R_{L1} and R_{L2} directly affect the measuring result and make it incorrect. Compensation of ± 5% is possible.



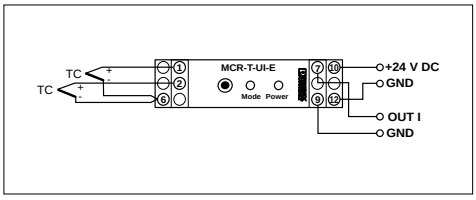
Application;

- Connection of a thermocouple or an mV signal.



Application;

- Differential temperature measurement using thermocouples.



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